Carleton University

Department of Electronics

Winter 2026

ELEC2507: Electronic - I

Introduction

This first-level Analog Electronics course which introduces the theory of semiconductor physics and p-n junctions. Fundamental electronic devices, namely, Diodes, Bipolar Junction Transistors (BJTs) and Metal-Oxide Semiconductor Field Effect Transistors (MOSFETs) are introduced, detailing their construction, operation and terminal current-voltage relations. DC as well as Small Signal Analysis, and the design of circuits containing these devices are covered.

Course Description and Requirements

Course Description: Diodes, Bipolar Junction Transistors (BJTs) and Metal-Oxide-Semiconductor Field Effect Transistors (MOSFETs) are explained. Important design applications for these devices are introduced, including diode-based rectifiers, BJT based CE, CB and CC Amplifiers and MOSFET based CS, CG and CD amplifiers. Design and analysis of operational amplifier circuits, and their use in simple active filters are studied.

Includes: Experiential learning activity to design and implement different diode, MOSFET and BJT based circuits
Prerequisite(s): ELEC 2501 and 2nd year status in Engineering
Lectures: 3 hours per week
Laboratory and problem analysis: 3 hours per week in an alternative week

Instructor

Professors: Masum Hossain & Hubert Jean-Ruel
Email: masumhossain@cunet.carleton.ca & hubertjeanruel@cunet.carleton.ca
Course Webpage: on Brightspace

Textbook: Please include price of required books

- 1) *Microelectronic Circuits*, 7th Edition, A. Sedra and K. Smith, Oxford. CAD ($150)

Lecture Outline

In person; consult Carleton Central for days, times, and locations.

The following topics will be covered during the course lectures with an approximate schedule:
Week 1: OP Amp and OP Amp based circuits, Inverting non-inverting Amp, Buffer
Week 2: Inverting non-inverting Amp, Buffer, Differential Amplifier
Week 3: Semiconductor, PN Junction and Diode, Bandgap structure
Week 4: Forward Biased, Reverse Biased Diode and Small signal model
Week 5: Zener Diode, Voltage regulator

Week 6: Rectifier, Half wave and Full wave rectifier
Week 7: Bipolar Junction Transistor (BJT) physics
Week 8: BJT small signal Model
Week 9: BJT Amplifiers: CB, CC, CE
Week 10: Metal Oxide and Semiconductor Field Effect Transistors (MOSFET) Physics
Week 11: MOSFET Small signal model and Amplifiers
Week 12: OP-Amp Circuits

Laboratory and Problem Analysis Sessions

3 hours (alternate weeks) as per schedule and location posted on Brightspace.

Notes for Labs

- There are 4 labs as follows:
  - Lab 1: OP Amp based Circuitry
  - Lab 2: Rectifier design
  - Lab 3: BJT amplifer
  - Lab 4: MOSFET Amplifer
- Labs are 3 hours in duration and will be held in Room ME4195. Labs and PA sessions usually "alternate" from week to week and will be held according to the schedule shown on the course module in Brightspace. You must attend your lab in the session you are registered. Changing sessions is not allowed without the instructor's permission. A TA will take attendance at each lab session.
- If for some reason a Lab needs to be rescheduled OR a Lab falls on one of the University holidays, students in those sections must try to rearrange their schedule to make up the lab in another of the regularly scheduled lab sessions, as arranged by the instructor.
- Attend each lab punctually. Be prepared for the lab experiment by reading the lab instruction sheets before entering the lab. Some labs have a pre-lab exercise that must be completed before the start of your lab period. You are not permitted to do the lab unless the prelab is completed. The TA will check that the the pre-lab has been completed.
- A lab report will be submitted online for each lab and by each student. Lab reports are due by midnight on the day of the lab. Late lab reports must still be submitted. One day late it will only be worth 50%. Two days late, it is worth 0.

Notes for PA Sessions

- Several problems will be assigned each week as homework to help understand the lecture material, prepare for the midterm exams and final exam. To learn the course material, **IT IS ESSENTIAL THAT YOU ATTEMPT SOLUTIONS FOR THESE PROBLEMS BEFORE THE PA SESSION**. Solutions to these problems will be reviewed in the PA sessions.

Self-Declaration form and Deferred Term work

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for submitting a self-declaration form no later than three (3) days after the date/deadline of term work including test/midterm, labs, assignments. Any alternate arrangements made with the instructor for submission of term

work should be made as soon as possible but within 3 days of the missed due date. If this is not possible after discussion with the instructor, alternate arrangements must be made before the last day of classes in the term as published in the academic schedule.

Instructors can require (or not) the student to submit the self-declaration form. Include the following statement if you require the student to submit a completed self-declaration form:

> **Consult with the instructor no later then 3 days after any missed course work or midterm examination.** or
>
> **Contact the instructor with the completed self-declaration form no later than 3 days after the date/deadline of term work including test/midterm, labs, assignments.**

Evaluation and Grading Scheme

The cumulative course grade will be determined as follows:

Labs (4)	20%
PA Session and Quizzes (4)	5%
Homework Problem Sets (HWPs) (5 each)	15%
Midterm Test	20%
Final Exam	40%
Bonus	5% (from HWPs or tests)

To pass the course you need: 50% overall, 45% in the final, complete 3 out of 4 labs

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Explain, Analyze and Design different types of amplifier and filter circuits using operational amplifiers.
2. Explain the theory of semiconductor physics, construction and operation of Diodes, Bi-Polar Junction Transistors (BJTS) and MOSFETS. Also Model the current-voltage relationship of these devices.
3. Perform DC as well as Small Signal Analysis of circuits containing Diodes, BJTs and MOSFETs.
4. Analyze and Design basic electronic building blocks: Diode based Rectifier Circuits, CE/CB/CC BJT Amplifiers and CS/CG/CD MOSFET Amplifiers

Graduate Attributes

The Canadian Engineering Accreditation Board requires graduates of undergraduate engineering programs to possess 12 attributes: Graduate-Attributes.pdf (engineerscanada.ca) or GA's. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's yearto-year progression through the program or eligibility to graduate. Accreditation metrics are based on courses common to all students in a program.

This following list provides the GAs that will be measured in this course, along with the indicators that are intended to develop and assess these attributes.

Graduate Attribute and Level	Indicators or Area for Specialization	Methods used for Evaluation
GA 3.1.1 A knowledge base for engineering	engineering fundamentals, and specialized engineering knowledge	Dedicated Exam Question
GA 3.1.2 Problem analysis	identify, formulate, analyze, and solve complex engineering problems	Dedicated Exam Question
GA 3.1.3 Investigation	appropriate experiments, analysis and interpretation of data, and synthesis	Dedicated Exam Question
GA 3.1.4 Design	design solutions for complex, openended engineering problems	Lab report and Dedicated Exam Question

Academic Integrity and Plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: https://carleton.ca/engineering-design/current-students/fed-academic-integrity. Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that the work you submit is your own. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- Any submission prepared in whole or in part, by someone else;
- Using another's data or research findings without appropriate acknowledgment;
- Submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own;
- Failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks; and
- Unless explicitly permitted by the instructor in a specific course, the use of generative AI and similar tools to produce assessed content (such as text, code, equations, images, summaries, videos, etc.).

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For accommodation

regarding a formally-scheduled final exam, you must complete the Pregnancy Accommodation Form (click here).

Religious obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details click here.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send us your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, contact us, if needed, to ensure that accommodation arrangements are made.

You should request your academic accommodations in the Ventus Student Portal, for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm.

Please consult the PMC website for the deadline to request accommodations for formally-scheduled exams (if applicable).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/equity/sexual-assault-support-services

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation will be provided to students who compete or perform at the national or international level. Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist: https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf